DOCUMENT RESUME

ED 040 054 SE 008 434

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| TITLE | The Use of Visual Advance Organizers for Learning Earth Science Concepts. |
| INSTITUTION | Jersey City State Coll., N.J. Dept. of Geoscience. |
| PUB DATE | Mar 70 |
| NOTE | 16p.; Paper presented at Annual Meeting of the National Association for Research in Science Teaching (43rd, Minneapolis, Minn., March 5-8, 1970) |
| EDRS PRICE | EDRS Price MF-$0.25 HC-$0.90 |
| DESCRIPTORS | *Concept Formation, *Earth Science, Grade 8, *Instruction, *Learning, *Secondary School Science |
| IDENTIFIERS | Advanced Organizers |

ABSTRACT

This study was designed to determine whether advance organizers in the form of visual aids might serve the same function as Ausubel's verbal advance organizers. The basic design of the study consisted of a 4 X 3 X 2 ANOVA factorial design. Ninety-six eighth-grade students were involved in the study. One group was exposed to a physiographic diagram of the North Atlantic Ocean Floor. A second group was exposed to a topographic profile of the North Atlantic Ocean Floor. A third group read a five-hundred word passage dealing with the same information as was covered on the other group of advance organizers. A fourth group functioned as a control group. Following the examination of the organizers, all students read a 1,100-word new learning task dealing with continental drift which used ocean floor features as illustration of the theory. ANOVA treatment of the post-test scores revealed that visual advance organizers functioned at a significant level whereas the expository organizer did not function for any of the groups in the study. (BR)

APR 17 1970

ED040054

# THE USE OF VISUAL ADVANCE ORGANIZERS FOR LEARNING EARTH SCIENCE CONCEPTS

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## The Problem

A general conclusion of research data from studies focused on various types of symbolic representations reveals a general conclusion that presentation of visual data seems to be superior to the presentation of verbal data when the verbal presentation is used alone.[1] However, most of the research has been limited to the testing of one form of visual presentation in comparision with a verbal form of presentation. Most research studies cannot draw conclusions about the comparative effects of a variety of visual forms of presentation currently in wide use by educators.

## The Model for Investigation

This study was inspired by research carried out by David P. Ausubel but had the added dimension of presenting data to children at a specific grade level in a selected discipline in science. Ausubel has developed an operational construct which he has called the "advance organizer". These organizers are introduced in advance of the new learning material itself, and are presented at a higher level of abstraction, generality, and inclusiveness.[2] Ausubel

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has limited his research thus far to the learning and retention of verbal materials, using an advance organizer having a verbal expository form.

Ausubel believes that the "advantage of deliberately constructing a special organizer for each new unit of material is that only in this way can the learner enjoy the advantage of a subsumer which both (a) gives him a general overview of the more detailed material in advance of his actual confrontation with it, and (b) also provides organizing elements that are inclusive of and take into account most relevantly and efficiently the particular content contained in this material".[3] The similarities between this definition and definitions for the effects and use of visual devices made by several authors are particularly striking.[4,5,6,7.]

This research examined the application of the advance organizer to a specific learning task to determine if a conceptual framework was developed by two types of visual advance organizers. The media chosen for the advance organizers were a map and graph versus a verbal form of advance organizer.

## Design and Procedures

The null-hypotheses which were developed for testing during this study are as follows:

1. There are no significant differences among the mean achievement scores of students exposed to various types of ad-

vance organizers.

2. There are no significant differences among the mean achievement scores of students placed in high, middle, and low categories of prior knowledge.

3. There are no significant differences among the mean achievement scores of students grouped by sex.

4. There are no significant interactions between scores of prior knowledge and the type of organizer presented to the students.

Three different type of organizers were prepared to relate information dealing with the new learning task. One organizer was a verbal description of the ocean floor approximately five hundred words in length and was the most abstract of the organizers presented to the test subjects. A second organizer consisted of a series of profiles across the North Atlantic Ocean floor. The third organizer used in the study was the Heezen-Tharp Physiographic Diagram of the North Atlantic Ocean Floor.

The new learning task to which all groups were exposed dealt with the features of the North Atlantic Ocean Floor as illustration of the Theory of Continental Drift. Those features shown on the map or graph, or discussed in the verbal organizer, were also discussed in the 1100 work subsequent learning task. This new learning task was a verbal treatment of the subject that used no maps, diagrams or graphs.

Finally, parallel forms of a forty-question, verbal, multiple-choice test were constructed for use as a pre-test and post-test in the study. The alternate-form method of measuring reliability was used in a trial phase prior to the experimental phase of the study. The alternate-form of measure is ideal because it measures more of the sources of reliability and measures them better than any other method.[8] The scores for both tests were correlated and the correlation was found to be 0.84. In addition, each test was analyzed for item choices and all options were functioning. The questions on the tests were almost evenly distributed according to each classification in the Knowledge Category of Bloom's Taxonomy of Educational Objectives.[9]

The students chosen for the experimental phase were eighth-grade students in the Jersey City ( N.J.) Public Schools. Four classes of students were chosen to serve as the test subjects for the organizers prepared for this study. One group of students served as a control group. They received no advance organizer prior to their exposure to the new learning task.

All students received the pre-test immediately before being placed into one of the test groups and before the exposure to the advance organizer. The students were divided by sex and by prior knowledge as reflected by categories of high, middle, or low. Prior knowledge was used to determine his or her standing and

assignment to the test group as determined by the score achieved on the pre-test. Each student was removed from the classroom and worked on an individual basis with the writer. They received no special instructions in examining the materials. The post-test was administered immediately following the new learning task.

## Experimental Design

The experimental design of this study was a 4 x 3 x 2 factorial design. The sample population of ninety-six students was evenly divided between boys and girls who had no prior instruction in oceanography.

Table I defines the various levels of the factors considered in this study.

TABLE I

DEFINITION OF FACTORS

| Factor | | Level | Definition |
|---|---|---|---|
| Advance Organizer | (A) | $A_1$ | Graph |
| | | $A_2$ | Map |
| | | $A_3$ | Verbal |
| | | $A_4$ | Control |
| Prior Knowledge | (B) | $B_1$ | High--top third |
| | | $B_2$ | Middle--middle third |
| | | $B_3$ | Low--bottom third |
| Sex | (C) | $C_1$ | Male |
| | | $C_2$ | Female |

The classification scheme contained a total of twenty-four cells; each cell contained four students. The students were categorized and then randomly assigned to each cell. As an example, the students in the $A_1$ $B_1$ $C_1$ cell were males who were in the upper third of the pre-test scores in their group. They were in the group which was exposed to an organizer in the form of a graph. Each successive B level represents an individual in the next lower level of prior knowledge. Each A level represents an individual using a different type of organizer.

## Statistical Procedures

The post-test scores were analyzed according to analysis of variance techniques (ANOVA). The probability level chosen to indicate the significance of difference was the 5 per cent level of probability. The interaction between the different variables considered in the study was also examined. The 5 per cent level of confidence was also chosen for acceptance or rejection of the null-hypotheses in this part of the study.

A post-hoc comparison was used to determine the pairs of means which were contributing to the over-all differences. Each statistically significant difference was examined by means of the post-hoc comparison.

Table II shows the design for the analysis of variance treatment of the study.

TABLE II

BASIC ANALYSIS DESIGN FOR ANOVA

| Source of Variation | | df |
|---|---|---|
| Treatment | (A) | 3 |
| Prior Knowledge | (B) | 2 |
| Sex | (C) | 1 |
| A x B | | 6 |
| A x C | | 3 |
| B x C | | 2 |
| A x B x C | | 6 |
| Residual (within cells) | | 72 |
| Total | | 95 |

## RESULTS OF THE ANALYSIS

Table III shows the analysis of variance for the three variables under consideration in the study. It also shows the F ratios for the interactions.

The analysis of the treatment groups yielded an F ratio of 13.73. This ratio is significant at the 5 per cent level and even at the 1 per cent level of probability given for a group with 3 degrees of freedom and 72 degrees of freedom for the within groups mean square.

The analysis of the knowledge categories yields an F ratio of 30.51. This ratio is significant at the 5 per cent level and even at the 1 per cent level of probability given for a group with 2 degrees of freedom and 72 degrees of freedom for the within the groups mean square.

The analysis of the categories of sex and the analysis of the various interactions between the variables revealed that neither of these examination yielded significant results.

A post-hoc comparison of the group means was carried out for the two variables which were found to be significant -- treatment and prior knowledge. The group means differences for the treatment groups which were larger than the interval range were found to be in the following order: $A_2$ and $A_4$, $A_2$ and $A_3$, $A_1$ and $A_3$, $A_1$ and $A_2$.

TABLE III

Analysis of Variance

| Source | Sums of Squares | df | Mean Squares | F |
|---|---|---|---|---|
| Treatment (A) | 494.042 | 3 | 164.680 | 13.73* |
| Knowledge (B) | 731.896 | 2 | 365.948 | 30.51* |
| Sex (C) | 30.375 | 1 | 30.375 | 2.53 |
| A x B | 69.271 | 6 | 11.545 | 0.96 |
| A x C | 42.875 | 3 | 14.291 | 1.19 |
| B x C | 12.438 | 2 | 6.219 | 0.51 |
| A x B x C | 49.562 | 6 | 8.260 | 0.68 |
| Within Groups | 863.500 | 72 | 11.993 | |
| Total | 2293.959 | 95 | | |

*F ratio significant at the 5 per cent level of probability.

The group mean differences in the knowledge groups which were larger than the interval range were found to be in the following order: $B_1$ and $B_3$, $B_2$ and $B_3$, $B_1$ and $B_2$.

## Discussion

It was hypothesized that there would be no significant differences between the specific types of media tested as advance organizers in this study. ANOVA treatment of the data revealed in the knowledge categories was also greater than 1 per cent probability level. Thus, the students in each category of prior knowledge did not perform equally well with each organizer presented to them.

Post-hoc comparisons revealed that the greatest group mean difference appeared between those students who were exposed to the map organizer and the control group. The group means of the control group and the group using the graph organizer were nearly the same as the control group-map group difference. A further examination reveals that the verbal organizer did not contribute significantly to the new learning task.

All group mean differences were greater than that required for the 95 per cent confidence level required. Table IV shows the post-hoc comparison.

On the basis of the ANOVA treatment of the data, the first null-hypothesis must be rejected. The map functions very well as an advance organizer; it can be handled quite well by all aptitude groups and by both sexes with equal facility. The graph functions almost as well as the map as an advance organizer. The results

raise serious questions as the value and use of verbal organizers; especially when other, more fruitful visual materials are available to us in the classroom and as supplementary materials in textbooks.

The results of the ANOVA treatment of the data also call for rejection of the second hypothesis. There are definite differences in performance among the students in the various categories of prior knowledge. All the organizers functioned well for boys and girls in the middle category of prior knowledge.

The third and fourth null-hypotheses must be accepted. Boys did equally as well as girls on all levels of prior knowledge and no significant interaction appeared between the prior knowledge categories and the treatment.

# TABLE IV

## POST-HOC COMPARISON

Group Mean Differences--Treatment

| | $A_1$ | $A_2$ | $A_3$ | $A_4$ |
|---|---|---|---|---|
| $A_1$ | - - | -0.08 | 4.0 | 4.2 |
| $A_2$ | 0.08 | - - | 4.8 | 5.0 |
| $A_3$ | -4.0 | -4.8 | - - | 0.2 |
| $A_4$ | -4.2 | -5.0 | -0.2 | - - |

Within Cells Mean Square = 11.993
g = ± 0.899

Group Mean Differences--Prior Knowledge

| | $B_1$ | $B_2$ | $B_3$ |
|---|---|---|---|
| $B_1$ | - - | 2.5 | 6.7 |
| $B_2$ | -2.5 | - - | 4.2 |
| $B_3$ | -6.7 | -4.2 | - - |

Within Cells Mean Square = 11.993
g = ± 0.734

The definitions and operational constructs developed by Ausubel and his associates are extremely nonspecific, limited and difficult to understand. In order to understand the concept of advance organizers in light of specific studies, one must refer to the specific organizers generated for the study. The definitions as stated by Ausubel are not concrete and thus, are open to wide interpretations; they are not easily defined on a general level of inclusiveness for all areas of interest.

According to Ausubel's definition, a non-functioning advance organizer would, by its failure, represent a non-organizer. This definition and interpretation is the only one that can be made from his definitions. But it is not satisfactory for one who wishes to examine organizers in respect to a particular area of interest. The definition is rather circular in nature and, unless interpreted broadly, does not open itself up to examination.

## SYNOPSIS

This study examines Ausubel's construct of the advance organizer. Graph and map visual media as advance organizers were tested against a verbal expository form of the advance organizer. Four groups of twenty-four eighth grade students each were exposed to the different organizers and a subsequent new learning task. ANOVA treatment of the post-test scores of each group revealed the visual advance organizers functioned at a highly significant level whereas the expository organizer did not function for any of the groups in the study. The results indicate that more valuable media are available for the organization of learning than the highly abstract verbal media previously used as advance organizers.

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